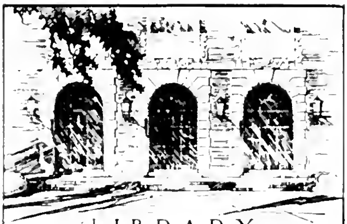

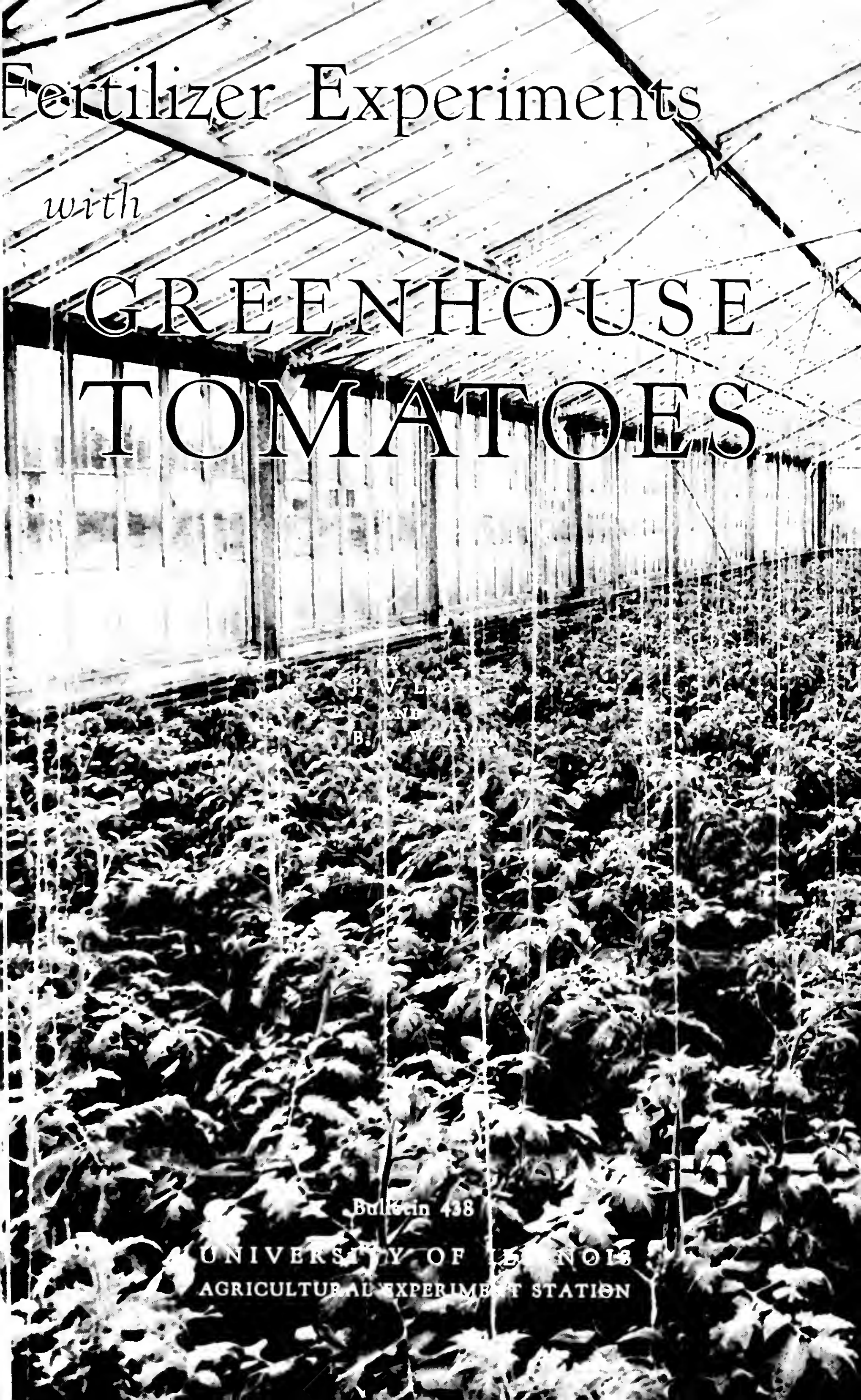

Fertilizer Experiments *with* GREENHOUSE TOMATOES

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Fertilizer Experiments With Greenhouse Tomatoes

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THE PRODUCTION of hothouse tomatoes is receiving increased attention by Illinois growers who are seeking to utilize their greenhouses to better advantage. For the inexperienced grower one of the first problems is the proper fertilizing of the soil.

Previous experiments by the Illinois Station in the fertilizing of outdoor tomatoes in southern,[4*] central,[5*] and northern[6*] Illinois and of greenhouse tomatoes grown as a late spring crop on raised benches[3*] have shown the importance of manure and phosphorus in the fertilizing of this crop under the conditions studied. Experiments in neighboring states also have indicated superior yields from the use of manure and phosphorus in the production of the outdoor crop.[1, 10*] Results of experiments in England[9*] where tomatoes are grown only under glass, suggested the possibility of different responses of tomatoes to specific fertilizer treatments at different seasons of the year, particularly treatments involving the use of nitrogen and potash.

In the light of these various experiments it was deemed advisable to run a series of tests in the fertilizing of greenhouse tomatoes grown in ground beds, as both fall and spring crops, particularly to determine the effect of fractional applications of nitrogen and potash at different stages of the plant's development, supplementary to a basic treatment of manure and phosphorus. Records were secured on six fall crops and four spring crops. Upon analyzing the data in reference to the fall crop it seemed advisable to conduct a supplementary test involving twelve replications to obtain further data regarding the relative yields of tomato plants treated with manure alone and with manure and superphosphate in the fall crop. Data on the main experiment and on the supplementary test are included in this report.

METHODS EMPLOYED IN THE EXPERIMENT

The tomatoes in the main experiment were grown in a new house, well exposed to light, which had been erected less than a year at the time the experiment was started in the fall of 1930. The dimensions of the house were 104 feet by 29 feet 9 inches inside the concrete walls. The walls were only 2 feet high, with 5 feet of glass from the top of the walls to the eaves of the house. There was a line of ventilators

on each side of the ridge but no side ventilation. Heating coils originally extended along all four walls but were removed from the east end of the house before the close of the experiment on account of excessive heat. Boards were laid for walks next to the pipe coils on all sides of the house, and there was a 12-inch board walk extending lengthwise thru the center of the house, dividing the available planting area into two strips each 12 feet wide and running the length of the house. Before planting each crop, the entire soil area within the walls was spaded and all board walks relaid afterwards.

The soil in the house was the dark-colored upland prairie soil common in the corn belt. The area had been used for the growing of vegetables for several years before the house was built and was in a fairly good state of fertility as a result of repeated manuring, tho no commercial fertilizer had been applied.

The house was laid out for planting 40 rows of tomatoes 30 inches apart crossways of the house, with the plants 18 inches apart in the row, each row consisting of 16 plants (8 on each side of the center walk). Thus the number of plants required to plant the house was 640. The first row and the fortieth were considered as buffer rows; the other 38 rows were arranged in pairs, each pair constituting a plot to receive a given fertilizer treatment. The same area was given the same treatment thruout the experiment. One row in each plot was planted to the Urbana Forcing variety and the other to the Lloyd Forcing.[2*]

The supplementary experiment conducted in the fall of 1936 was in a different house, in which the soil had been uniformly treated with manure for previous crops.

Fertilizer Applications

Before planting each crop the soil thruout the house received a heavy, uniform dressing of rotted manure which was well mixed with the soil by spading.

The manure was not weighed nor measured, but was probably equivalent to at least 30 tons an acre. After spading, the soil was raked smooth and marked out for planting. All applications of fertilizers other than manure were made after planting.

In the main experiment a basic application of superphosphate equivalent to 1,000 pounds of 16-percent superphosphate an acre was made to practically all the plots, including those designated as check plots. This material was supplemented by nitrate of soda or muriate of potash, or both, applied either early or late, or both early and late, on various plots. The early application of nitrate was equivalent to 375 pounds of 15.5-percent nitrate of soda an acre, and the late appli-

cation was of the same amount. Each 375 pounds was divided into two 187½-pound applications. There was an interval of three weeks between successive applications. The muriate of potash was applied in

TABLE 1.—FERTILIZER TREATMENT OF THE VARIOUS TOMATO PLOTS

Plot	Basic treatment	Supplementary treatment	
		Early	Late
1 (check)	Manure and superphosphate	None	None
2	Manure alone	None	None
3	Manure and superphosphate	Nitrate	None
4 (check)	Manure and superphosphate	None	None
5	Manure and superphosphate	Nitrate	Nitrate
6	Manure and superphosphate	Nitrate	Potash
7 (check)	Manure and superphosphate	None	None
8	Manure and superphosphate	None	Nitrate
9	Manure and superphosphate	None	Potash
10 (check)	Manure and superphosphate	None	None
11	Manure and superphosphate	Potash	Nitrate
12	Manure and superphosphate	Potash	None
13 (check)	Manure and superphosphate	None	None
14	Manure and superphosphate	Potash	Potash
15	Manure and superphosphate	Nitrate and potash	None
16 (check)	Manure and superphosphate	None	None
17	Manure and superphosphate	None	Nitrate and potash
18	Manure and superphosphate	Nitrate and potash	Nitrate and potash
19 (check)	Manure and superphosphate	None	None

TABLE 2.—STAGES OF PLANT DEVELOPMENT WHEN FERTILIZERS WERE APPLIED AT THREE-WEEK INTERVALS

Year	First application, days after setting plants	Second application		Third application		Fourth application		Days from last application to ripe fruit
		Height	Clusters in bloom	Height	Clusters in bloom	Height	Clusters in bloom	
Fall crop								
		ft.		*ft.*		*ft.*		
1930	7	.....	2d	.....	4th to 5th	Top[a]	6th to 7th	−7
1931	11	.....	3d	5-6	5th	Top	7th	−9
1932	12	3-3½	2d to 3d	5½-6	5th to 6th	Top	7th to 8th	−9
1933	9	2½-3	2d	4½	4th	6-7	6th to 7th	1
1934	10	3½	2d	6	5th	Top	7th to 9th	−11
1935	10	2-2½	1st	4½-5	3d to 4th	6½-7	6th	14
Spring crop								
1932	8	2	1st	4-5	3d to 4th	6½-7	7th	4
1933	7	1½-2	1st	3½-4	3d to 4th	5-6	6th	4
1934	5	1½-2	1st	4-4½	4th	5½-6½	6th to 7th	0
1935	15	1½-2	1st	4	4th	6	6th	14

[a]"Top" = top of trellis, 7½ feet from ground. The plants were topped when they reached this height.

like manner in amounts equivalent to 200 pounds of 50-percent potash an acre early and the same amount late.

Since light conditions were expected to be different on the north and the south sides of the house, the half of each plot on each side of the center walk was treated as a separate unit. The area occupied by the 16 plants in each half-plot was 5 by 12 feet, which is equivalent to 1/726 acre. To insure accuracy, the fertilizer for each half-plot was weighed separately in grams.

All initial applications of fertilizer were made between five and fifteen days after the plants had been transplanted into the experimental house, the time varying somewhat according to the size of the plants when set. The superphosphate was scattered as uniformly as possible over the entire area of each plot except that care was taken to avoid having the material come in direct contact with the plants, and that no material was placed under the narrow boards that served as walks between the plots. The nitrate and potash were each scattered in a circle approximately 10 inches in diameter about each plant. Subsequent applications of these two materials were made in a similar manner. Immediately after the fertilizers were applied they were thoroly raked into the soil.

The fertilizer treatment of the various plots in the main experiment is indicated in Table 1; and the stage of development of the plants at the time of each application is indicated in Table 2.

Growing the Plants

In producing the plants to be used in these experiments, the seed was sown in flats placed on a greenhouse bench. While still very small, the plants were pricked out into 2½-inch pots which were plunged in the bench. Except for the 1935-36 fall crop, the plants were shifted to 4-inch pots before being transplanted to the fruiting house. In all the potting a soil composed of 4 parts garden loam, 2 parts rotted manure, and 1 part fine sand was used. Many more plants than needed were started so that a uniform lot could be selected when planting the house.

In starting the plants for the fall crop an attempt was made to have the plants ready to set in the house as soon as the excessive heat of summer was over and in time for the main crop of blossoms to set their fruit before the dark days of December arrived. The starting of the plants for the spring crop was timed with a view to having them in prime condition for planting within a few days after the harvest of the fall crop was completed. Thus there would be prac-

tically no loss of use of the house between crops and the harvest of the spring crop would be completed before local outdoor tomatoes became abundant. Dates of planting and harvesting the various crops involved in the experiment are given in Table 3.

TABLE 3.—DATES OF PLANTING AND HARVESTING TOMATOES FROM EXPERIMENTAL PLOTS

Year	Date seeded	Date set in house	Date of first picking	Days from seed to harvest	Date of last picking	Length of harvest in days
			Fall crop			
1930-31.......	July 22	Sept. 3	Nov. 5	106	Jan. 26	82
1931-32.......	Aug. 3	Sept. 21	Nov. 25	114	Feb. 1	68
1932-33.......	July 30	Sept. 2	Nov. 7	100	Jan. 13	67
1933-34.......	Aug. 1	Sept. 5	Nov. 17	108	Feb. 2	77
1934-35.......	Aug. 6	Sept. 10	Nov. 11	97	Feb. 5	86
1935-36.......	Aug. 17	Sept. 14	Dec. 10	115	Feb. 8	60
Average.....	....	....	....	107	....	73
			Spring crop			
1931-32.......	Dec. 19	Feb. 4	Apr. 19	121	July 5	77
1932-33.......	Dec. 17	Jan. 31	Apr. 15	123	June 30	76
1933-34.......	Dec. 16	Feb. 5	Apr. 14	119	July 5	82
1934-35.......	Dec. 23	Feb. 6	May 6	134	July 19	74
Average.....	....	....	....	124	....	77

Pruning and Training

The tomato plants were pruned to single stems by repeated removal of side shoots as they appeared, and were tied to upright cords fastened to crosswires at the top and to looped wires forced into the ground at the bottom. Tyings at intervals of about one foot were necessary to keep the plants in place. The top of the trellis was 7½ feet from the ground, and the plants were topped when they reached that height. The number of clusters per plant varied from seven to nine, depending largely upon the length of the internodes, which varied somewhat from season to season and from plant to plant.

Pollination

Pollination was effected by merely tapping the clusters of blossoms or the supporting cord with a padded stick. This was done every day, usually in the early afternoon and preferably when the sun was shining brightly. This method of pollinating was effective with the varieties used, since both were heavy pollen producers with the stigmas advantageously located in reference to the anthers.

Watering and Ventilation

Care was taken to give the tomato plants optimum moisture conditions. Watering was usually withheld as long as possible after planting in order to reduce damping-off. Care was also taken to prevent the water from coming into direct contact with the plants. The frequency of watering varied with the weather and the stage of development of the crop. The general practice was to water heavily at each watering, and then to withhold water as long as feasible. Watering in dark weather was avoided as much as possible.

Ventilation was given special attention in order to reduce danger from leaf mold and other foliage diseases. An abundance of heat was kept on, and whenever practicable the vents were left partly open in order to prevent the air from becoming too moist. The aim was to maintain a temperature of 60° to 65° F. at night, 65° to 70° F. on cloudy days, and 75° to 80° F. on clear days. On hot days during the early fall and late spring, however, the temperature frequently was from 90° to 95° F. in the house, and sometimes even higher, in spite of having all heating pipes cut off, all vents wide open, and the roof shaded with whitewash.

Harvesting the Crop

The tomatoes were allowed to become red-ripe upon the vines, and were picked from two to three times a week, depending upon the season of the year and the rapidity of ripening. The product of each half-row (8 plants) was picked separately and sorted into marketable fruits and culls, on the basis of size and relative smoothness. All fruits weighing less than 1½ ounces each were classified as culls regardless of how smooth they might be; and all rough or misshapen fruits, no matter how large they might be, were likewise regarded as culls. Each grade from each lot was counted and weighed separately. The harvest usually continued for at least ten or eleven weeks, so that there were normally from twenty to thirty pickings in each crop.

YIELDS FROM THE DIFFERENT FERTILIZER TREATMENTS

For ease of comparison the yields were calculated in terms of ounces per plant and average number of fruits per plant. Only the fruits of marketable grade were considered when comparing yields. The averages for the six fall crops included in the main experiment are given in Table 4 and for the four spring crops in Table 5. The average weights per marketable fruit are also included in these tables.

TABLE 4.—FALL CROP: YIELDS OF TOMATOES PER PLANT, SIX-YEAR AVERAGE

Plot	Supplementary treatment (See Table 1)	Urbana Forcing		Lloyd Forcing		Weight per fruit	
		Weight	Number of fruits	Weight	Number of fruits	Urbana	Lloyd
		oz.		oz.		oz.	oz.
2	(Manure alone)	58.5	18.6	73.6	25.5	3.14	2.88
3	N early, 0 late	60.1	19.0	68.6	23.7	3.16	2.89
5	N early, N late	61.6	20.5	68.4	24.3	3.05	2.81
6	N early, K late	63.6	20.9	66.6	24.2	3.04	2.75
8	0 early, N late	63.9	20.9	64.8	23.4	3.06	2.77
9	0 early, K late	58.0	19.0	62.1	22.5	3.05	2.76
11	K early, N late	64.4	21.2	69.3	24.5	3.04	2.83
12	K early, 0 late	61.2	19.5	67.2	23.5	3.14	2.86
14	K early, K late	63.9	21.2	69.0	24.3	3.01	2.84
15	NK early, 0 late	63.4	20.7	69.2	23.9	3.06	2.89
17	0 early, NK late	64.6	22.1	68.9	24.6	2.92	2.80
18	NK early, NK late	59.3	20.0	64.5	23.6	2.96	2.73
	Average of treated plots	61.9	20.3	67.7	24.0	3.05	2.72
	Average of checks (MsP)	61.5	20.1	68.2	24.0	3.06	2.84

TABLE 5.—SPRING CROP: YIELDS OF TOMATOES PER PLANT, FOUR-YEAR AVERAGE

Plot	Supplementary treatment (See Table 1)	Urbana Forcing		Lloyd Forcing		Weight per fruit	
		Weight	Number of fruits	Weight	Number of fruits	Urbana	Lloyd
		oz.		oz.		oz.	oz.
2	(Manure alone)	153.6	36.5	163.8	45.0	4.21	3.64
3	N early, 0 late	153.6	37.8	166.6	43.7	4.06	3.81
5	N early, N late	142.6	35.8	167.5	44.6	3.98	3.75
6	N early, K late	143.7	34.7	156.6	44.0	4.14	3.55
8	0 early, N late	151.1	37.5	153.5	44.1	4.00	3.48
9	0 early, K late	138.3	34.6	160.7	45.3	4.00	3.54
11	K early, N late	150.0	37.6	175.0	46.7	3.98	3.74
12	K early, 0 late	155.4	37.7	170.1	46.1	4.12	3.68
14	K early, K late	156.3	37.3	168.3	46.7	4.19	3.60
15	NK early, 0 late	162.5	37.3	170.5	47.0	4.35	3.60
17	0 early, NK late	148.4	37.6	166.2	45.1	3.94	3.68
18	NK early, NK late	151.2	37.7	157.6	45.0	4.01	3.50
	Average of treated plots	146.3	36.8	164.7	45.6	4.08	3.62
	Average of checks (MsP)	151.9	36.4	166.5	45.8	4.17	3.63

Spring Crop Much Larger Than Fall

There were striking differences in yield between the fall and the spring crops. In the spring the average number of fruits per plant was 80 percent greater for Urbana Forcing and 90 percent greater for Lloyd Forcing than in the fall. The average size of fruit in both

varieties was approximately one-third larger in the spring than in the fall. With both number and size of fruits greater in the spring the yields in weight were necessarily much larger in spring, averaging nearly 2½ times the fall yields. Furthermore there was less variation in yield from year to year in the spring crop than in the fall crop.

The average yields from all check plots, including both varieties, for each year show that the yields in the fall varied from 49 to 94 ounces per plant (Table 6). This indicates that the yields in the fall one year may be nearly double those of another year under the same fertilizer treatment. Such variations in yield are attributable largely to variations in weather conditions, particularly intensity and amount of sunlight during the setting and development of the fruit. On the other hand, the average yields from the spring check plots varied only from 143 to 169 ounces per plant, a difference of only 18 percent between the lowest crop and highest crop during the four seasons.

TABLE 6.—AVERAGE YIELDS PER PLANT FROM ALL CHECK PLOTS OF BOTH VARIETIES EACH SEASON

Year	Fall crop	Spring crop
	oz.	*oz.*
1930-31	68	...
1931-32	49	163
1932-33	59	143
1933-34	61	169
1934-35	94	161
1935-36	55	...
Average	64	159

Incidentally these results indicate a justification for the common practice among commercial growers of growing only the spring crop.

No Advantage in Nitrogen or Potassium Supplements

Data presented in Tables 4 and 5 indicate that there was little difference between the average yields from all treated plots and from all check plots during the period of the experiment. Each year some of the treated plots showed slight increases in yield (from 3.6 to 13.4 percent) over the average of the checks for that season, but the same plot did not appear as the high-yielding plot with sufficient frequency to make the results significant.

A better basis for determining the effectiveness of the different fertilizer treatments is a statistical analysis of the yield from each treated plot each season compared with its adjacent check. The summary of such an analysis of the yields in ounces per plant is presented

TABLE 7.—FALL CROP, URBANA FORCING: YIELD OF MARKETABLE TOMATOES, SIX-YEAR AVERAGE

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	M.D./P.E.
2	(Manure alone)........	58.5	8.58 ± 2.05	93:1	4.2
3	N early, 0 late..........	60.1	−4.83 ± 1.32	51:1	3.7
5	N early, N late.........	61.6	−3.25 ± 1.51	9:1	2.2
6	N early, K late.........	63.6	−1.75 ± 1.70	3:1	1.0
8	0 early, N late..........	63.9	−1.42 ± 2.00	2:1	.7
9	0 early, K late..........	58.0	−2.17 ± 2.09	3:1	1.0
11	K early, N late.........	64.4	4.25 ± 2.09	8:1	2.0
12	K early, 0 late..........	61.2	−3.92 ± 1.41	18:1	2.8
14	K early, K late.........	63.9	−1.17 ± 1.47	2:1	.8
15	NK early, 0 late........	63.4	1.33 ± 1.56	2:1	.9
17	0 early, NK late........	64.6	2.50 ± 1.64	5:1	1.5
18	NK early, NK late......	59.3	−4.08 ± 1.43	21:1	2.9
	Average of treated plots.	61.9	....	....	...
	Average of checks (MsP).	61.5	....	....	...

TABLE 8.—FALL CROP, LLOYD FORCING: YIELD OF MARKETABLE TOMATOES, SIX-YEAR AVERAGE

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	M.D./P.E.
2	(Manure alone)........	73.6	12.58 ± 2.59	198:1	4.9
3	N early, 0 late..........	68.6	−1.42 ± 1.53	3:1	.9
5	N early, N late.........	68.4	−1.67 ± 1.76	3:1	1.0
6	N early, K late.........	66.6	−4.00 ± 1.50	17:1	2.7
8	0 early, N late..........	64.8	−5.75 ± 1.93	24:1	3.0
9	0 early, K late..........	62.1	−10.58 ± 1.64	1110:1	6.5
11	K early, N late.........	69.3	−3.33 ± 1.45	11:1	2.3
12	K early, 0 late..........	67.2	− .75 ± 1.53	2:1	.5
14	K early, K late.........	69.0	1.08 ± 1.29	2:1	.8
15	NK early, 0 late........	69.2	2.08 ± 1.42	4:1	1.5
17	0 early, NK late........	68.9	1.83 ± 1.11	5:1	1.7
18	NK early, NK late......	64.5	−3.67 ± 1.16	30:1	3.2
	Average of treated plots..	67.7	....	....	...
	Average of checks (MsP).	68.2	....	....	...

in Tables 7, 8, 9, and 10.[a] Each variety has been considered separately for the fall and the spring crop. Since the yield records were kept separately for the given treatment on each side of the greenhouse, twelve yield records for each treatment in the main experiment are available for the fall crop and eight records for the spring crop. This

[a]An analysis was also made on the basis of number of fruits per plant, but since the results were not essentially different, only the data covering the one analysis are presented here.

TABLE 9.—SPRING CROP, URBANA FORCING: YIELD OF MARKETABLE TOMATOES, FOUR-YEAR AVERAGE

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	$\frac{M.D.}{P.E.}$
2	(Manure alone)........	153.6	.87 ± 1.65	2:1	.5
3	N early, 0 late..........	153.6	2.00 ± 2.70	2:1	.7
5	N early, N late.........	142.6	−9.00 ± 2.57	30:1	3.5
6	N early, K late.........	143.7	−1.09 ± 3.75	<1:1	.3
8	0 early, N late..........	151.1	5.05 ± 3.88	4:1	1.3
9	0 early, K late..........	138.3	−16.12 ± 1.71	3332:1	9.4
11	K early, N late.........	150.0	−4.05 ± 1.79	9:1	2.3
12	K early, 0 late..........	155.4	−1.05 ± 1.98	2:1	.5
14	K early, K late.........	156.3	− .75 ± 2.68	<1:1	.3
15	NK early, 0 late........	162.5	4.37 ± 3.69	3:1	1.2
17	0 early, NK late........	148.4	−9.50 ± 3.97	11:1	2.4
18	NK early, NK late......	151.2	−6.62 ± 3.90	5:1	1.7
	Average of treated plots..	146.3	....	....	...
	Average of checks (MsP).	151.9	....	....	...

is a sufficient number of items to render the results of the statistical study reliable.

The significance of the differences in yield were determined by two methods, viz.: (1) Student's "odds"[11, 12*] and (2) mean difference divided by probable error. Odds of less than 30 to 1 indicate that there was no significant difference in the yields of the two plots under comparison, while odds greater than 30 to 1 indicate that the difference was significant.[7, 8*] On the other basis of comparison, where the mean

TABLE 10.—SPRING CROP, LLOYD FORCING: YIELD OF MARKETABLE TOMATOES, FOUR-YEAR AVERAGE

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	$\frac{M.D.}{P.E.}$
2	(Manure alone)........	163.8	7.38 ± 3.32	9:1	2.2
3	N early, 0 late..........	166.6	9.87 ± 3.64	14:1	2.7
5	N early, N late.........	167.5	5.25 ± 3.73	4:1	1.4
6	N early, K late.........	156.6	−9.25 ± 2.00	88:1	4.6
8	0 early, N late..........	153.5	−10.88 ± 2.23	108:1	4.9
9	0 early, K late..........	160.7	−10.62 ± 2.93	34:1	3.6
11	K early, N late.........	175.0	3.62 ± 2.76	4:1	1.3
12	K early, 0 late..........	170.1	2.87 ± 2.99	3:1	1.0
14	K early, K late.........	168.3	1.13 ± 1.43	2:1	.8
15	NK early, 0 late........	170.5	−4.75 ± 2.98	5:1	1.6
17	0 early, NK late........	166.2	−9.50 ± 3.91	11:1	2.4
18	NK early, NK late......	157.6	−7.00 ± 2.63	14:1	2.7
	Average of treated plots..	164.7	....	....	...
	Average of checks (MsP).	166.5	....	....	...

difference is divided by the probable error, a quotient of less than 3.2 indicates that there was no significant difference between the yields under comparison.

In the fall crop apparently the only significant increase in yield as compared with that of the adjacent check plot was on the plot treated with manure alone. The increase appeared to be significant in both varieties and by both methods of calculation. However, the check plot with which the manure-treated plot was compared was at the extreme east end of the house, with only a single buffer row of plants between it and the wall. The yield from this check plot was unduly depressed, so that the difference in yield was due partly to the low yield of this particular check. These results led to the supplementary test reported on pages 286-7.

The only other significant differences in the fall crop in the main experiment were decreases rather than increases in yield compared with the adjacent checks. Plot 3, treated with nitrate of soda early in the season, showed a significant decrease in yield of Urbana Forcing; and altho there was some decrease in yield of Lloyd Forcing the difference was not significant. Plot 9, treated with potash late in the season, showed a significant decrease in yield of Lloyd Forcing, but not of Urbana Forcing. When the two varieties were combined (Table 11), the decrease in yield for Plot 9 was significant. Plot 18, treated with both nitrogen and potash early and late, showed a significant decrease in yield for the two varieties combined and for Lloyd Forcing,

TABLE 11.—FALL CROP, BOTH VARIETIES COMBINED: YIELD OF MARKETABLE TOMATOES

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	M.D./P.E.
2	(Manure alone)	66.0	10.58 ± 1.67	5998:1	6.4
3	N early, 0 late	64.3	−3.12 ± 1.04	32:1	3.0
5	N early, N late	65.0	−2.46 ± 1.17	10:1	2.1
6	N early, K late	65.1	−2.88 ± 1.14	16:1	2.5
8	0 early, N late	64.3	−3.58 ± 1.42	16:1	2.5
9	0 early, K late	60.0	−6.38 ± 1.45	251:1	4.4
11	K early, N late	66.8	.46 ± 1.37	<1:1	.3
12	K early, 0 late	64.2	−2.34 ± 1.05	12:1	2.2
14	K early, K late	66.4	− .04 ± .99	<1:1	.0
15	NK early, 0 late	66.3	1.70 ± 1.06	6:1	1.6
17	0 early, NK late	66.7	2.16 ± .98	11:1	2.2
18	NK early, NK late	61.9	−3.88 ± .92	192:1	4.2
	Average of treated plots	64.7	....	....	...
	Average of checks (MsP)	64.8	....	....	...

TABLE 12.—SPRING CROP, BOTH VARIETIES COMBINED: YIELD OF MARKETABLE TOMATOES

Plot	Supplementary treatment	Ounces per plant	Increase over adjacent check	Odds	$\frac{M.D.}{P.E.}$
2	(Manure alone)........	158.7	4.12 ± 2.19	7:1	1.9
3	N early, 0 late..........	160.1	5.93 ± 2.36	15:1	2.5
5	N early, N late.........	155.1	−1.87 ± 2.56	2:1	.7
6	N early, K late.........	150.1	−5.17 ± 2.23	12:1	2.3
8	0 early, N late..........	152.3	−2.91 ± 2.62	3:1	1.1
9	0 early, K late..........	149.5	−13.37 ± 1.76	8100:1	7.6
11	K early, N late.........	162.5	.22 ± 1.77	<1:1	.1
12	K early, 0 late..........	162.7	.91 ± 1.82	2:1	.5
14	K early, K late.........	162.3	.19 ± 1.77	<1:1	.1
15	NK early, 0 late........	166.5	− .19 ± 2.50	<1:1	.1
17	0 early, NK late........	157.3	−9.50 ± 2.79	47:1	3.4
18	NK early, NK late......	154.4	− .19 ± 2.62	<1:1	.1
	Average of treated plots..	155.5	....	....	...
	Average of checks (MsP).	159.2	....	....	...

but not for Urbana Forcing. When the records of the two varieties were combined 24 items entered into the calculations, instead of the 12 items when the two varieties were considered separately.

Eight treatments showed decreases in yield of each variety as compared with the adjacent checks, but only in the plots mentioned above were the differences significant.

In the spring crop the only significant results were negative; that is, the differences in yield were significant only in those plots where the yields were less than in the adjacent checks. Plot 9 in each variety showed significantly decreased yields, evidently due to the potassium applied late. Lloyd Forcing in Plot 6, treated with nitrogen early and potassium late, and in Plot 8, treated with nitrogen late, also showed significant decreases in yield. Urbana Forcing in Plot 5, treated with nitrogen both early and late, also showed a significant decrease in yield. When both varieties were combined (Table 12), the only significant differences in yield in the spring crop were in Plots 9 and 17. The fertilizer treatments of both of these plots involved the application of potash late in the season.

Manure Alone Proved Equal to MsP for Fall Crop

In order to obtain additional data on the effect of manure alone on tomato yields, a supplementary test was made in the fall of 1936. Twenty-four rows each of Urbana Forcing and Lloyd Forcing were included in this test. Alternate plots of two rows each were treated

TABLE 13.—MANURE ALONE COMPARED WITH MANURE AND SUPERPHOSPHATE IN PRODUCING MARKETABLE TOMATOES: FALL CROP, 1936

	Urbana Forcing	Lloyd Forcing	Both varieties combined
Average yield with manure, ounces per plant	60.84	75.82	68.33
Average yield with manure and superphosphate	56.37	73.26	64.81
Mean difference	4.47	2.56	3.52
Probable error	1.59	2.08	1.32
Mean difference divided by probable error	2.8	1.2	2.7
Odds	19:1	3:1	2:1

with manure alone, and with manure and superphosphate. In analyzing the results, the yield of each row was paired with that of the nearest row receiving the other treatment. The differences in the yields from the two treatments proved not to be significant (Table 13). In the light of these results the more limited data from the spring tests, showing no significant yield differences between the manure and manure-phosphate plots, are worthy of note.

(For *Conclusions* see next page.)

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NITROGEN OR POTASH, or both, used as top dressings to supplement a liberal basic treatment of manure and phosphorus, cannot be depended upon to increase the yield of greenhouse tomatoes grown in ground beds of dark-colored Illinois upland prairie soil. In fact, such treatments may be more detrimental than beneficial.

Where ample supplies of manure are available, the fall crop of greenhouse tomatoes, and probably the spring crop also, may advantageously be grown on ground beds of the kind of soil used in these experiments without any kind of commercial fertilizer supplement.

The small fall crops of tomatoes obtained in these experiments indicate that commercial growers are justified in their common practice of producing only the spring crop.

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